

The Honorable James M. Inhofe
United States Senate

May 19, 2013

My dear Sir,

It is a pleasure to communicate with you.

On August 2, 1939, Albert Einstein sent an historic letter to President Roosevelt in which he warned quite clearly that the United States might suffer dire consequences should we not place a national priority on the study of the atom. He perceived that immediate action was necessary, not merely to maintain a lead in an emerging science. He perceived that our failure to do so might soon present *an existential threat*.

This is another such letter.

In the 74 years since, easily extractable oil in the lower 48 has gone boom to bust, and atoms are now providing roughly a third of our electrical power. But there has arisen a new threat.

As my children mature, if we carry on our present course they will inherit a world where we have devastated the economy and any renaissance of industry and energy self-sufficiency is not merely unlikely, but impossible.

We have slept for too long.

The time to gather acorns is in the Fall, and we are there now. Some seventy years ago had I climbed a rooftop in Duncan I might have been in clear sight of dozens of productive oil wells, and at night the flares burning off unwanted natural gas would light up the sky.

But we are not squirrels. We are clever enough to know that some day there will not be enough acorns. We are clever enough to gather, barter and transport things from other places at progressively greater cost, find ways to hide that cost; and unfortunately that same cleverness allows us to engage in whole eras of procrastination without innovation.

This is why I devote my time suggesting the idea that specifically, the Liquid Fluoride Thorium Reactor (LFTR) and the molten salt technology that makes it the "safest" possible reactor, represents the only possible energy source that is on the table today and will be still fulfilling its promise in one hundred years' time.

I will not go into details of the technology of which I'm sure you are aware, and the paper copy of this letter will include a couple copies of a DVD (which is available on the Internet here¹) ... two hours twenty minutes featuring lectures by Kirk Sorensen, a modern-day Johnny Appleseed of this idea. He makes the case better than I. For me this one video was life-changing, for I have long wrestled with an anxiety that despite all the exciting things that are happening in the world today, we have been *losing ground* on energy.

¹ https://www.youtube.com/watch?v=IG1YjDdI_c8
Or search Youtube for "thorium remix 2011 dvd"

I frankly do not understand just why and how the United States abandoned the path to energy independence to vie with others for energy on the global marketplace. Any superpower that does not attain self-sufficiency in energy production is operating at a loss, on borrowed time. It should have been quite evident as we began to see our world lead in manufacture and innovation decline.

In thorium and molten salt research there is tragedy also. In 1973 Alvin Weinberg was *fired* from Oak Ridge Labs for his persistence in advocating molten salts, and his publicly expressed concerns of the danger of water-based reactors such as those in use today. His work *shelved, forgotten*. Graduates in nuclear physics today are often not even aware of the existence of this technology. If he had been given the opportunity to pursue his dream I am certain this would be a very different world. A better world.

Weinberg's dismissal was such a watershed event, a turning point, I firmly believe that in the future energy historians will look back on the period 1973-2013 and wonder how things might have been had this event not occurred. Hopefully the story will have a happy ending with Thorium research 'reborn' in our time.

There will not be support at the outset from those who presently sell nuclear energy in my opinion. Their business models are so heavily vested in solid fuel, their mindset generally bitter --- for they have operated nuclear plants in this country safely and at highest possible efficiency for decades with only public distrust and Hollywood vilification as a reward. It is sad to say, but I anticipate more resistance from them than say, potential oil and gas investors.

So we are left with an uneducated public anxious about radiation, a government which promotes dead-end non-scalable sources. Yet it is not too late.

In lectures Sorensen is repeatedly asked just what it might take to bring this technology into reality, given that Oak Ridge had already 'proven' it with an operational prototype some 44 years ago.

(Please forgive me, but) advocates of solar and wind who are practiced in the skill of baby boomer carbon indulgence guilt would chime in at this point and state flatly that it would take at least ten billion dollars. To start. Or schmillion or gazillion.

Even *fusion research* has been abused thus as a convenient backstop along with solar and wind, something so 'comfortably distant' that it is not perceived as an immediate threat by people terrified of radiation or by existing energy interests. *Solar and Wind* are unworkable paths leading directly to extinction, unworthy of discussion let alone massive funding. I demand base load energy and the same or greater level of prosperity for my children, not less. But I often find myself surrounded by people who seem unable or unwilling to do the math. In light of this existential threat I *rue every penny* spent on things that we *know* will not work well enough and soon enough to preserve our way of life.

Sorensen is earnestly looking for *a couple hundred million dollars* to develop LFTR technology to prototype, perhaps *another couple hundred million* to refine that prototype to become ready for rapid deployment and mass production. When asked about time frames he (candidly and

cleverly) gives two examples of urgency, the Manhattan Project model where "everyone is asked to drop everything" to work on a vital project, and money is not an issue. He says he prefers a more relaxed but assured "skunk works" approach in which the pace is slower but time to market is extended to more than a decade.

I actually differ with him on this point. At times our modern world seems to be laced with invisible economic and political tripwires that did not exist even a decade ago. Just this month the Kewaunee Nuclear Power Station on the shore of Lake Michigan was shut despite a perfect safety record, six months' fuel left in the reactor and 20 years left on license --- merely because Dominion is vested in natural gas and is playing the market by cents on the kilowatt-hour. Nuclear power professionals go so far as to consider this shutdown *an act of corporate vandalism*, and I would agree. How many such traps and trials will we need to overcome? All the more reason to start urgently and soon.

I have seen stats that actual proven natural gas reserves in Oklahoma represent some 11 years' worth of current production. I'm sure I could find better and worse figures out there easily. I know the actual useable figures are multiples of this and would not dare dispute them. Suffice to say that today the acorns --- investment capital --- are here and available. Now is the best time to crack this *existential* energy problem.

I feel the need for us to jump in the direction of Thorium with resolve, in a nationally coordinated effort similar to that which placed men on the moon. I hope that by my own and others' efforts Sorensen will find his funding and necessary support from state and federal government.

The reactors he is proposing are *so different* from the water-based reactors of today, many existing NRC guidelines and procedures such as those geared to prevent steam/hydrogen explosion and sudden dispersal of radioactivity into the atmosphere, *do not even directly apply*.

Operating without water (and the explosive hydrogen that separates from it) and operating at normal atmospheric pressure, molten salt reactors trump the safety issue. Molten salt reactor designs simply do *not* present a risk of explosion or uncontrolled wide release of radiation into the atmosphere.

The radioactive salts, even if blown clear of the reactor by some hypothetical terrorist attack, will merely sit on the ground and solidify. They would not continue to fission, or react with water or air. Even this worst-case scenario is one where the hazardous material is directly approachable for cleanup and re-use. I implore everyone to research this technology and reach their own conclusion about this truth.

Therefore a Chernobyl or Fukushima or Three Mile Island is not possible with LFTR. It is merely an industrial process that requires a concrete foundation and good measure of occupational safety to operate. And unlike some industrial processes in use today, this one is "walk-away safe". Alvin Weinberg knew all this in 1973 and he sacrificed the remainder of his career in a vain attempt to communicate this directly to the public.

This radical difference to water reactors is a *good thing*, and we need to re-assess fission in light of LFTR's promise.

We also need to air out the fog of fear and prejudice about radioactivity that pervades our culture today. There are so many facts about radioactivity that are unknown to the public. How naturally prevalent it is, the mathematical principle of the logarithmic scale, how nuclear power plants are at times held to levels of emission lower than that of the surrounding countryside. The difference between a steam explosion, a hydrogen explosion and a 'mushroom cloud'. The public is also generally unaware of the ongoing release of radioactivity into the environment from hydrocarbon extraction. The failure to prove the Linear No Threshold hypothesis by directly correlating cancer rates in populations exposed to varying yet low levels of manmade or natural radioactivity².

If more people were aware of the levels of radiation exposure they receive every day and were better able to parse the units presented to them, they would be able to apply risk assessment in the same way they do other things, such as deciding whether to wear seat belts. But I identify a single point in history when for a great many, nuclear energy was taken 'off the table'.

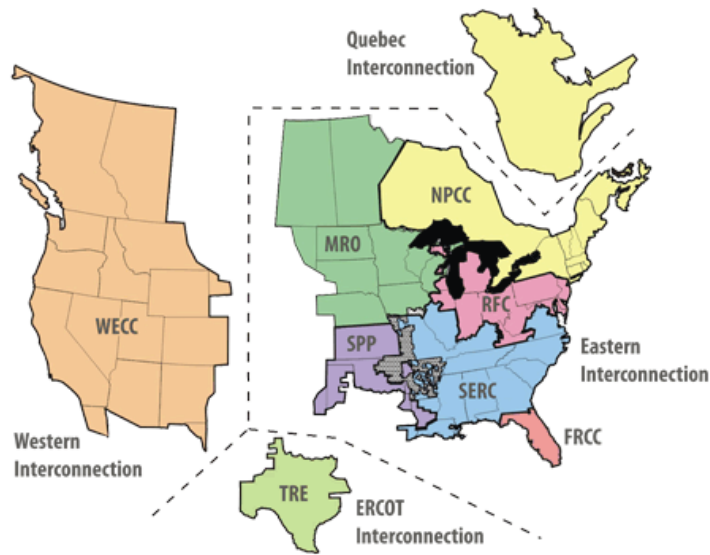
China Syndrome [1979] was a damned good movie. Although it depicted events which would lead into a disaster like Chernobyl, the real brilliance of this screenplay was that the movie ends the moment before it occurs, leading the viewer to imagine the outcome. Nuclear power advocates came out in force in an attempt to discredit its premises and some of their statements were disingenuous and misleading, yet I believe public perception of nuclear power might have reached a moderate balance point if not for another event. Twelve days after the film's release Three Mile Island broke into the news.

The terrifying prescience of the film to what happened days later resounded deeply. It was keenly felt here in Oklahoma where it helped the grassroots campaign of Carrie Barefoot Dickerson gain sufficient momentum to end construction of the Black Fox Power Plant. *Syndrome* with its falsification of inspection records also reminded Oklahomans of the tragic plight of Karen Silkwood whose story would be re-told in the film *Silkwood* [1983].

If Weinberg had convinced the government to move forward and bring molten salt designs to market, these tragedies would not have been avoided. The plants were already under construction and operating. But in the least --- in answer to *China Syndrome*, advocates of atomic energy might have had something better to suggest than "just trust us".

Every worst case scenario of nuclear disaster from meltdown to spent fuel ignition involves issues specific to the pressurized water reactor. We need to convince people there is more than one way to do it.

² Linear No-Threshold Relationship Is Inconsistent with Radiation Biologic and Experimental Data
<http://radiology.rsna.org/content/251/1/13.full>



North American Grid

<http://www.thetexasconomy.org/natural-resources/media/electricGridPrimer-Exhibit1.png>

Oklahoma should be building *energy pipelines* in addition to oil and gas pipelines.

I advocate a renaissance in the development of new and additional base load electricity generating capacity, and Oklahoma is geographically positioned to do this. It stands physically at the intersection of three grids and through revenue agreements or the construction of energy pipes through existing corridors, might reach two more.

Today we build plants to feed the HVAC grid directly, but in the next generation I would like to see a network of efficient, high current conduits crisscrossing the state carrying HVDC electrical power from natural gas --- and as soon as possible --- molten salt reactors. This DC could be rendered directly into properly synchronized AC at each grid interconnect, putting Oklahoma on the map as *a direct value-added supplier and transport purveyor of electrical energy from cost to coast.*

Faulkner [report attached] describes the reasoning and methodology for the use of long haul HVDC conduits, or "energy pipelines" as he calls them. I treasure this report because no one else seems to have described this concept as well.

I would like to see HVDC piping scaled to the national level, eventually to span all continents, gradually replacing our present aerial pylon corridors with compact subterranean conduits that make use of existing infrastructure, such as "cut and drop" into superhighways and beside railways. I believe moving energy distribution below ground is essential for our survival of natural threats such as volcanic eruption, meteor impact or severe Winter storms.

Oklahoma could be a proving ground for HVDC energy pipeline technology. It would create an opportunity for the state to become an electrical base load giant serving most of the country, a gateway between grids.

As LFTRs come on line all natural gas presently used for electricity generation can be re-tasked to the domestic production of commodities that are dear to agriculture, helping to bring us beyond self-sufficiency to a grand surplus of fertilizer and its components.³

LFTR reactors need not make electricity. They will also be an efficient and reliable source of heat to drive the industrial process directly --- such as hydrocarbon recovery from shale, water desalinization and purification, synfuels from coal using the Fischer-Tropsch process. In many areas the input of additional heat or electrical energy to filter, sequester or break down waste products can make a dirty process *clean*.

Imagine what our energy balance sheet might look like if every bit of natural gas, oil and coal presents itself with a net energy cost of production approaching zero.

Imagine a bountiful Oklahoma exporting a surplus of electricity while it provides completely for its own farmers and those in neighboring states with fertilizer and fuel.

This could and would be done today with natural gas. But as LFTR plants begin to come on-line to completely supplant electrical and process heat generation within the next *ten years*, this condition of 'bountiful Oklahoma' would continue in perpetuity.

If LFTR is fully developed and scaled up quickly in our time... on that day far into the future when the last hydrocarbon extraction effort is finally shut down, it is my daydream that life will go on as usual --- and history will laud those such as yourselves for helping to deliver the gift of true *stability* during the long transition period from fossil to fission.

This is what 'sustainable energy' should have meant all along, an ever increasing use of safe fission to satisfy all electrical demand and free our hydrocarbons for use as liquid fuel and chemical precursors. To extend existing reserves of these things over the greatest possible time span, and provide 'free' energy to use increasingly aggressive methods to extract more. *This* is the best of all possible futures we might leave to our children.

One would think the oil and gas industry would be all over this. But that seems to be the problem: people just aren't. What is wrong here? Have we raised whole generations of people who are individually and collectively programmed to wait for someone else to take *that first step*?

China will take that step --- but not necessarily in a way that will guarantee our survival or financial sovereignty. I for one would rather see the US perfect this technology that *we* have developed, soon to build and deploy LFTR plants with the same verve as we once built battleships and airplanes.

Attached with this letter is another that I recently wrote to Halliburton Corporate. Please give it a read for it touches on other topics such as LFTR fabrication not included here.

³ <http://www.ers.usda.gov/data-products/fertilizer-importexports/summary-of-the-data-findings.aspx>

While I felt it appropriate to present these ideas to Halliburton directly, I fear that like the direction not taken on molten salt reactor development itself... such appeals are too often lost in the noise of today's world.

So feel free to forward all my letters --- including Halliburton's --- around to anyone in any industry who might take an interest or be able to help in this endeavor, particularly those in the oil, gas and coal industry.

I have also attached a copy of *Electric Pipelines for North American Power Grid Efficiency & Security* by Roger W. Faulkner [2005].

Two quotes from Kirk Sorensen I find particularly relevant: "There is no such thing as nuclear waste... only unburned fuel." And "If we do not get this message out to *everyone*... nothing's going to change."

Thanks kindly for listening,

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